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Establish soft tissue cephalometric standard norms of Legan – Burstone (COGS) Analysis for ethnic Himachalli population – A cephalometric study

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Abstract
Aim: The purpose of the study was to establish soft tissue cephalometric standard norms of Legan – Burstone (COGS) Analysis for ethnic Himachalli population.
Materials and Methods: The Lateral cephalograms of sample size of one hundred Himachalli ethnic subjects that met the inclusion criteria in Natural Head Position (NHP) were taken and subjected to Digital soft tissue facial analysis using Nemoceph. Establishment of soft tissue norms for Himachal ethnicity in relation to various cephalometric parameters was done using Shapiro-Wilk test and the level of significance for the present study was fixed at p-value of less than 0.05.
Results: The facial convexity angle, Neck to Lower third angle and lower lip protrusion was found statistically significant (p<.01).
Conclusion: The present study suggested that a slightly convex facial profile, protrusive lower lip and obtuse Neck to Lower third angle is acceptable in the Himachalli population with slightly retrognathic mandible and slightly prognathic maxilla.

Keywords: Legan – Burstone Analysis, Soft Tissue, Himachalli, Cephalometric Norms, Nemoceph Software

Introduction
Beauty of the face is an ill-defined concept that is obvious to the observer and recognized cross-culturally. In recent years, it was suggested that certain cephalometric standards relating teeth to cranial or facial bones could ensure good facial form if adhered to the treatment goals[1]. For the improvement of facial esthetics, Arnett and Bergman discussed cephalometric soft tissue facial analysis with eighteen soft tissue traits.[1] In addition, Legan and Burstone (COGS)[2] discussed cephalometric soft tissue facial analysis with 13 soft tissue traits.

Due to a complicated interaction of genetic and environmental factors, the morphological features of an individual vary from race to race. Even within the same race, each subgroup has its own standards. Hence, the established norms for other ethnic group cannot apply to the Indian population. Much of the research demonstrates that soft tissues, which vary considerably in thickness, are a major factor in determining a patient's final facial profile. Nevertheless, recommendations for various Dentoskeletal standards as a goal for treatment are still used that ignore soft-tissue thickness factors in treatment planning. Analysis of dental and skeletal patterns alone might be inadequate or misleading, because of marked variation in the soft tissues covering the Dentoskeletal framework.[3] The improvement in facial esthetics and functional occlusion are two desirable objectives of orthodontic treatment. These racial groups must be treated according to their own characteristics.[1] Normative data of cephalometric measurement are essential to determine the degree of variation from normal.

As previously stated,[3] the established norms for other ethnic group cannot apply to the Indian population. Moreover, Indian population is polygenetic and is an amalgamation of various races and cultures of different states. Across the various states, Himachal Pradesh is one of the many few states that has been inhabited since prehistoric times and has not witnessed human migration from other areas; largely due to difficult terrain comprises of predominantly mountain region led to have different genetic makeup with varied soft tissue traits.

There are numerous studies done internationally for instance, Alcade et al.[4] developed soft tissue norms for Japanese adults and found that analyses based on Caucasian norms are not applicable as a reference for the diagnosis and treatment of Japanese patients. Imani and Hosseini et al.[5] evaluated soft tissue characterization of Kurds was more convex and they had more prominent lips and smaller nose compared to Caucasians.

However, the number of studies for the Indian community is limited. Till date, no studies have been found in the literature to establish the Soft Tissue cephalometric Standard Norms of Legan – Burstone (COGS) Analysis for Himachalli Population. It enables us to differentiate between the Ethnic Himachalli population to rest of the other population and what is acceptable to their population for orthodontic diagnosis a point of view so that we can achieve desired goals through appropriate treatment planning.

Therefore, the purpose of the study was to establish Soft Tissue Cephalometric Standard Norms of Legan – Burstone (COGS) Analysis for Ethnic Himachalli Population.

Materials and Methods
This study was carried out in the Department of Orthodontics and Dentofacial Orthopedics of Himachal Institute of Dental Sciences, Paonta Sahib (H.P.). The Subjects with age group of 18 – 25 years who were native (four ancestral generations) of different districts of Himachal Pradesh were considered. All subjects were examined by a panel of the faculty members of Department of Orthodontics and Dentofacial Orthopedics. The Lateral Cephalogram of the One Hundred Himachalli were studied.

To formulate the soft tissue Cephalometric norms for Ethnic Himachal Pradesh population, reasonably balanced faces were selected based on the following criteria: Class I molar occlusion

with minimal or no incisal crowding, Normal growth and Development, All teeth present except third molars, Age group of 18-25 years (i.e. young adults), Straight profile or pleasing profile on extra oral examination, No craniofacial defects Syndrome or Non-Syndromic, No previous history of orthodontic treatment, No significant medical history, No history of trauma, No history of maxillofacial or plastic surgery.

The subjects were first assessed clinically, in natural head position, seated condyles, and with lips at rest. Then, facial examination (frontal, profile) was used as described by Arnett and Bergman.[3] After subjects were selected, informed and written consent was obtained from subjects and the cephalogram were taken.

Lateral cephalogram in the Natural Head Position was recorded based on the method proposed by Cooke and Wei [6] (1988). In this method, the subject was asked to tilt the head forward and backward with decreasing amplitude until a comfortable position of natural balance was achieved, the subject was then told to look into the reflection of their eyes in a mirror located 120 cm ahead and 3m from ground. The subjects were asked to swallow and bite into centric occlusion. Thus, a Cephalogram was obtained with subjects positioned in natural head position, seated condyle and with lip at rest. (Fig: 1)

After the radiographs were obtained in Carestream format using CS imaging software they were transferred to the laptop preloaded with (Nemoceph) Dental Studio NX (2006) software by using LAN where these were converted and stored in the form of "jpg" image format in the computer with Window 7 ultimate. The following landmarks were identified on each lateral cephalogram.(Fig :2)

1. Glabella (G)
1. Columella point (Cm)
2. Subnasale (Sn)
3. Labrale Superius (Ls)
4. Labrale Inferius (Li)
5. Stomion Superius (Stm_s)
6. Stomion Inferius (Stm_i)
7. Mentolabial Sulcus (Si)
8. Soft tissue Pogonion (Pg')
9. Soft tissue Gnathion (Gn')
10. Soft tissue Menton (Me')
11. Cervical point (C)
12. Machine Porion (P)

Horizontal reference plane (H P), constructed by drawing a line through Nasion 7° up from Sella (s) - Nasion (n) line For digital tracing, the soft copies of all lateral cephalograms were transferred to Nemoceph (Nemoceph Dental Studio NX, 2006) (Fig: 3). The images were calibrated by identifying two crosshairs 10mm apart. Once all the landmarks were marked, these landmarks were again adjusted and corrected for accurate measurements. All angular and linear measurements were automatically calculated by the Nemoceph tracing software and was subjected to statistical analysis.

Reliability of the measurements

The Inter-operator reliability testing was done by repeating and comparing the tracing of randomly selected 20 samples from the groups and it was found statistically insignificant, which is an agreement with the findings of Chen et al.[7-8]

Table 1 Comparison of facial form of legan – burstone soft tissue cephalometric analysis for himachalli ethnic population

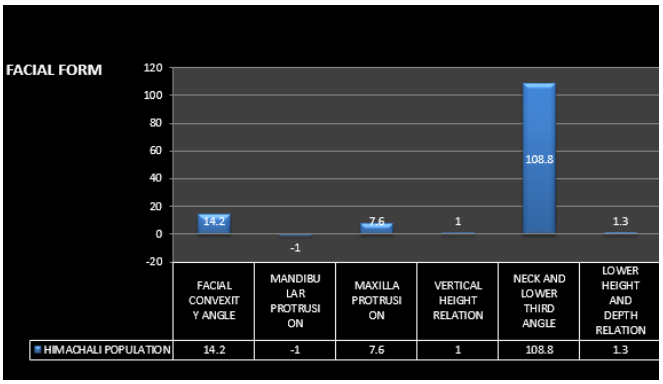
Facial Form	**Sample size (N)**		
		Himachalli	**p-value**
		Mean ±S.D	
Facial Convexity Angle	100	14.25 ±5.81	**<.001*****
Mandibular Protrusion	100	-1.00 ±12.19	.129
Maxilla Protrusion	100	7.62 ±7.93	.830
Vertical Height Relationship	100	1.06 ±0.58	.501
Neck and Lower Third Angle	100	108.80 ±12.39	**.007****
Lower Height and Depth Relationship	100	1.32 ±.50	.595

Statistically significant value at *p≤0.05, **p≤0.01, and ***p≤0.001

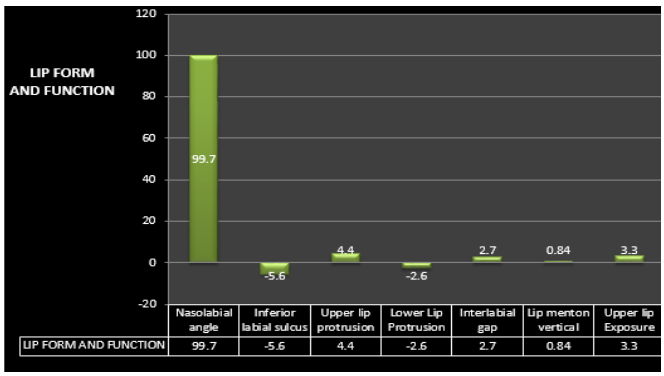
Table 2 Comparison of Lip form and function of Legan – burstone soft tissue cephalometric analysis for himachalli ethnic population

Lip Form and Function	Sample size (N)		
		Himachalli	P-value
		Mean ±S. D	
Nasolabial Angle	100	99.77±18.20	**.002***
Inferior Labial Sulcus	100	-5.68±1.76	.553
Upper Lip Protrusion	100	4.46±10.91	.397
Lower Lip Protrusion	100	-2.60±2.29	**.002***
Interlabial Gap	100	2.70±1.35	.068
Lip Menton vertical relationship	100	0.84±12.03	.278
Upper Incisor Exposure	100	3.35±2.03	.703

Statistically significant value at *p≤0.05, **p≤0.01,



Graph: 1 Graphical presentation of legan – burstone soft tissue cephalometric analysis for himachalli ethnic population



Graph:2 Comparison of legan – burstone soft tissue cephalometric analysis for himachalli ethnic population

Fig: 1 Patient position while taking lateral cephalogram in natural head position (NHP)

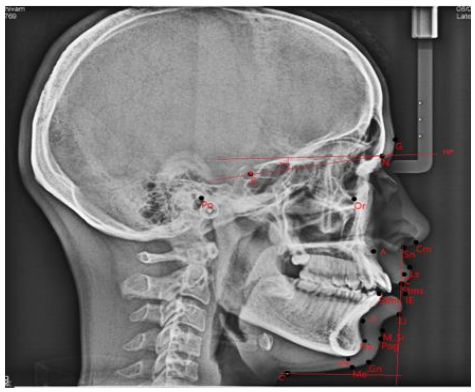


Fig: 2 Cephalometric landmarks

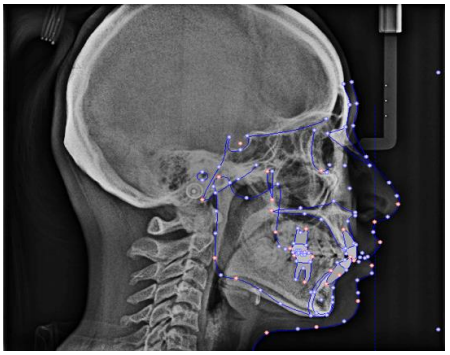


Fig: 3 Lateral cephalogram depicting landmarks and digital tracing done using nemoceph software

Results

Results were analyzed statistically to establish the soft tissue cephalometric norms of the Himachalli subjects. Statistical analysis was done using SPSS (Statistical Package for the Social Sciences) version 16, IBM Corp., USA.). Normality testing of the data using Shapiro-Wilk test showed that the data were normally distributed. Using the independent t-test the level significance was kept at $p < 0.05$. Table: 1 illustrates statistically significant differences were observed between Himachalli and North - Eastern groups in relation to Facial Convexity Angle ($p<0.001$), and Neck and Lower Third Angle ($p=0.007$). Table: 2 illustrates statistically significant differences were observed between Himachalli and North - Eastern groups in relation to Nasolabial Angle ($p=0.002$), and Lower Lip Protrusion ($p=0.002$).

Discussion of Results

The nature of the soft tissue profile is affected by many factors, including ethnicity. However, it is difficult to quantify and it may vary in its perception across the ethnic groups. The purpose of this study was to derive soft tissue profile norms of the Himachalli population.

The present study was carried out in the Department of Orthodontics and Dentofacial Orthopaedics of Himachal Institute of Dental Sciences, Paonta Sahib, which is located in the Southern part of Himachal Pradesh. A sample of one Hundred people (55 males and 45 females) who were resident of Himachal Pradesh in the age group of 18-25 years was considered for this study. As the profile varies according to malocclusion type, the present study used only Class I population with minimal or no crowding and no previous history of orthodontic treatment and orthognathic surgery so that, more authentic values could be reproduced for the particular population without selection bias. The lateral cephalogram was recorded based on the method proposed by Cooke and Wei (1988).[6]

To evaluate the facial aesthetics various soft tissue analysis such as profile analysis by A. M Schwarz,[9] Steiner's Analysis,[10] Rickett's profile Analysis,[11] Soft tissue Cephalometric Analysis for Orthognathic Surgery (COGS) by Harry L Legan – Charles J. Burstone,[2] Holdaway's Analysis,[12] Soft Tissue Cephalometric Analysis by G

William Arnett's[13] and Epker' s Soft tissue Analysis[14] may be used.

Intra-class correlation coefficients (ICCs) were calculated to evaluate method reliability. Most measurements showed ICCs above 0.86 and highly significant correlations ($p<0.01$) with cephalometric variables

The Legan – Burstone (COGS) Analyses,[2] were used to measure and determine soft tissue facial profiles in the present study. In Facial Form parameters, difference between the mean values for Facial Convexity Angle, Neck and Lower Third Angle were found to be significant with a p-value of $p <0.001$, $p=0.007$ respectively. Other differences were statistically insignificant ($p>0.05$). The mean values were 14.25º ± 5.81º, 108.80º ± 12.39º respectively for Himachalli Ethnic Population. (Table:1, Graph :1)

The results of the present study are in agreement with the findings of, Imani and Hosseini et al.,[4] Alcade and Jinno et al,[15] Kalra and Jain et al,[16] Celebi and Tan et al.,[17] with respect to the facial form measurements in whole where Facial Convexity angle and Neck – Throat angle were found to be statistically significant in Kurdish population of Iran,[4] Turkish- European American adults,[17] North Indian Ethnic population,[18] Japanese – Caucasian population,[19] respectively.

Facial convexity angle or facial profile angle or facial contour angle

In the present study, mean value was 14.25º ± 5.81º for Himachalli population and slightly lowered compared to Legan – Burstone reference value of 12º ± 4º; [2] Freitas and Freitas (White Brazilians 14.88º ± 5.91º and Black Brazilians 12.98º ± 4.89º for females.[5] As the positive angle increases, the profile becomes more convex, suggesting a Class II skeletal and dental relationship for the Himachalli population. However, the angle of facial convexity is not specific as to the location of the deformity.[2] The present study suggests that a slightly convex facial profile is acceptable in the Himachalli population.

Neck and lower third angle or face to throat angle

In the present study, the mean values were 108.80º ± 12.39º for Himachalli Ethnic Population compared to Legan – Burstone reference value of 100º ± 7º.[2] This showed that Himachalli population had obtuse Neck and Lower Third Angle suggestive of more anteroposterior facial dysplasia. An obtuse Neck and Lower Third Angle should warn the clinician not use a procedure that reduces the prominence of the chin excessive submental fat contributing to the bulk of neck or low hyoid bone position through its mechanical location and attachment of submental musculature increase the angl.[2] The present study suggests that a slightly retrognathic mandible and slightly prognathic maxilla the Himachalli population is considered agreeable**.**

On comparison of Lip Form and Position, difference between the mean values of Nasolabial Angle, Lower Lip Protrusion was found to be statistically significant with p-value of $p=0.002$, $p=0.002$ respectively. Differences among the rest of the parameters were statistically insignificant ($p>0.05$). (Table -2, Graph -2).

The nasolabial angle

The mean values were 99.77º ± 18.20º for Himachalli Ethnic Population respectively. The results of the present study are in agreement with the findings of, Freitas and Freitas et al (Black population 89º ± 12º).[4] Miyajima K and James A et al in European – American population (82.2º to 111º),[19] Nandini et al in Andhra population (range of 91.4º to 138.97º).[20] On contrary, result of Himachalli Ethnic Population is in agreement to the findings of Legan – Burstone reference value (102º ± 8º).[2] The present study suggests that slightly low nasal tip position and slightly thick maxillary lip gives prognathic maxilla for the Himachalli population considered agreeable.

Lower lip protrusion

In the present study, the mean values of Himachalli ethnic population were - -3.62 ± 2.62 respectively compared to Legan – Burstone[2] reference value (2.0 ± 1.0). This indicated that Himachalli population had protruded lower lip and lower incisors which are comparable to Freitas and Freitas et al.[5] (white population, 1.58 ± 2.04) less than black population study done by Freitas and Freitas et al.[5] (6.25 ± 2.12). On contrary, all four of the measurements were found to be statistically significant in finding of Imani and Hosseini[4] between the Kurdish population of Iran and the Caucasian. The result of Imani and Hosseini, [4] where eleven of thirteen measurements i.e., Facial Convexity Angle, Mandibular Protrusion, Maxillary Protrusion, Neck, and Lower Third Angle, Lower Height and Depth Relationship, Nasolabial Angle, Inferior Labial Sulcus, Lower Lip Protrusion, Interlabial Gap, Lip Menton Vertical Relationship, Upper Incisor Exposure were found statistically significant. The mean values of Nasolabial angle, upper and lower lip protrusion was found to be statistically significant between white and black population in findings of Freitas and Freitas et al.[5] The present study suggests that Himachalli population was found to be more Lower Lip Protrusion compared to reference value of Legan and Burstone.

The data gathered in this study indicates differences in measured parameters when compared to similar studies done on Caucasians by Legan and Burstone et al.,[2] Malaysian Indian and Malaysian Chinese by Purmal and Alam et al.[1] South Indian by Kalha and Latif et al , [3] Brazilian by Freitas and Freitas et al,[5] Japanese by Alcalde and Jinno et al.,[15] Turkish – European Americans by Celebi and Tan et al , [17] North Indian by Sanchan and Srivastav et al and by Kalra [16 , 18] Egyptians and North Americans by Bishara S and Abdalla et al, [21] similar studies done on Negroids by Sushner et al (1977) other African Blacks by Naidoo and Miles and Flynn et al.[23], Korean and American - European by Hwang et al.[33] , Central India by Raghav and Baheti et al,[34] Iranian by Ghorbanyjavadpoura and Rakhshanb et al.[35]

Conclusion

1. In the Present Study, Facial Form parameters, the results of the findings showed that the Himachalli subjects had more convex, protrusive dentition and jaws with a tendency towards horizontal growth pattern was agreeable to Himachalli population. Also, showed that a slightly retrognathic mandible, convex profile was acceptable.
2. In reference to Lip form and function, the findings of the result showed that the Himachalli population had slightly low nasal tip position and slightly thick maxillary lip lead to prognathic maxilla considered agreeable.
3. The norms obtained should not be used strictly as rules, but rather it should be used as a guide or basis for comparison. Orthodontics should be cognizant of these differences when interpreting measurements and must individualize the treatment planning using local norms as reference

Source of Funding

None.

Conflict of Interest

None.

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